

# New Hampshire Volunteer Lake Assessment Program

## 2002 Bi-Annual Report for Lake Monomonac Rindge



NHDES  
Water Division  
Watershed Management Bureau  
6 Hazen Drive  
Concord, NH 03301



# OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **LAKE MONOMONAC**, the program coordinators recommend the following actions.

We would like to encourage the association to conduct more sampling events in the future. Typically we recommend that associations sample three times per summer (once in June, July, and August). We understand that the number of sampling events you decide to conduct per summer will depend upon volunteer availability, and your associations' water monitoring goals and funding availability. However, with a limited amount of data it is difficult to determine accurate and representative water quality trends. Since weather patterns and activity in the watershed can change throughout the summer, and from year to year, and even from hour to hour during a rain event, it is a good idea to sample the lake at least once per month over the course of the season. Furthermore, with the recent problems with milfoil and the generally large size of the lake, it would be beneficial to include additional sampling events. If you are having difficulty finding volunteers to help sample or pick-up or drop-off equipment at one of the labs, please give the VLAP Coordinator a call and we will try to help you work out an arrangement.

If your association's sampling events this year were limited due to not having enough time to pick-up or drop-off samples at the lab in Concord, **please remember that the Franklin Pierce College Water Quality Lab is open at the college in Rindge.** This lab was established to reduce the driving time for the VLAP monitors in the southwestern region of the state. This lab is inspected by DES and operates under a DES approved quality assurance plan. We encourage the lake association to utilize this lab next summer for all sampling events (except for our annual visit, of course!). To find out more about the lab, or to schedule dates to pick up bottles and equipment, please call Susan Rolke the lab manager, at (603) 899-1045, ext. 5108.

## **FIGURE INTERPRETATION**

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water

column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration found in the water gives an estimation of the concentration of algae or lake productivity. **The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 ug/L.**

Similar to the summer of 2001, the summer of 2002 was filled with many warm and sunny days and there was a lower than normal amount of rainfall during the latter-half of the summer. The combination of these factors resulted in relatively warm surface waters throughout the state. The lack of fresh water to the lakes/ponds reduced the rate of flushing which may have resulted in water stagnation. Due to these conditions, many lakes and ponds experienced increased algae growth, including filamentous green algae (the billowy clouds of green algae typically seen floating near shore), and some lakes/ponds experienced nuisance cyanobacteria (blue-green algae) blooms.

The current year data (the top graph) show that the chlorophyll-a concentration in June was **greater than** the state mean.

Overall, the statistical analysis of the historical data (the bottom graph) shows that the mean annual chlorophyll-a concentration has **not significantly changed** since monitoring began. Specifically, the chlorophyll-a concentration has **fluctuated**, but has not *continually increased or decreased* since monitoring began in 1987. (Note: Please refer to Appendix E for the detailed statistical analysis explanation and data print out.)

Please note that this trend is based on a limited amount of data. As your association expands its sampling program to include sampling at the deep spot on more than one event per season, we will be able to analyze the data with more accuracy and confidence.

While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Therefore, algal concentrations may increase when there is an increase in nonpoint sources of nutrient loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). It is important to continually educate residents about how activities within the watershed can affect phosphorus loading and lake quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

Two different weather related patterns occurred this past spring and summer that influenced lake quality during the summer season.

In late May and early June of 2002, numerous rainstorms occurred. Stormwater runoff associated with these rainstorms may have increased phosphorus loading, and the amount of soil particles washed into waterbodies throughout the state. Some lakes and ponds experienced lower than typical transparency readings during late May and early June.

However, similar to the 2001 sampling season, the lower than average amount of rainfall and the warmer temperatures during the latter-half of the summer resulted in a few lakes/ponds reporting their best-ever Secchi-disk readings in July and August (a time when we often observe reduced clarity due to increased algal growth)!

The current year data (the top graph) show that the in-lake transparency in June was **less than** the state mean.

Overall, the statistical analysis of the historical data (the bottom graph) show that the mean annual in-lake transparency has **not significantly changed** (either *increased* or *decreased*). Specifically, the in-lake transparency has **fluctuated** since monitoring began in 1987. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.)

Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from NHDES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The current year data for the epilimnion (the top inset graph) show that the total phosphorus concentration in June was ***approximately equal to*** the state median.

The current year data for the hypolimnion (the bottom inset graph) show that the total phosphorus concentration in June was ***slightly less than*** the state median.

Overall, the statistical analysis of the historical data show that the phosphorus concentration in the epilimnion (upper layer) has ***significantly decreased*** since monitoring began. Specifically, the phosphorus concentration in the epilimnion has ***improved*** on average by ***approximately 3 percent*** per sampling season during the sampling period **1987 to 2002**. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.) We hope this trend continues!

Overall, the statistical analysis of the historical data show that the total phosphorus concentration in the hypolimnion (lower layer) has ***not significantly changed*** (either *increased* or *decreased*) since monitoring began in **1987**. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.)

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands. If you would like to educate watershed residents about how they can help to reduce phosphorus loading into the lake/pond, please contact the VLAP Coordinator.

**TABLE INTERPRETATION****➤ Table 2: Phytoplankton**

Table 2 lists the current and historic phytoplankton species observed in the lake/pond. The dominant phytoplankton species observed this year were ***Chrysosphaerella* (a golden-brown algae), *Anabaena* (a cyanobacteria), and *Xanthidium* (a green algae).**

Phytoplankton populations undergo a natural succession during the growing season (Please refer to page 12 of the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire’s less productive lakes and ponds. An overabundance of cyanobacteria (previously referred to as blue-green algae) indicates that there may be an excessive total phosphorus concentration in the lake/pond, or that the ecology is out of balance.

**➤ Table 2: Cyanobacteria (Blue-green algae)**

***Anabaena***, a cyanobacterium, was one of the dominant species observed in the plankton sample this season. ***This species, if present in large amounts, can be toxic to livestock, wildlife, pets, and humans.*** Cyanobacteria can reach nuisance levels when excessive nutrients and favorable environmental conditions occur.

As with the summer of 2001, we observed that some lakes and ponds had cyanobacteria present during the 2002 summer season, likely due to the many warm and sunny days that occurred this summer, which may have accelerated algal and bacterial growth. In addition, the lower than normal amount of rainfall during the latter half of the summer, meant that the slow flushing rates resulted in less phosphorus exiting the lake outlet and more phosphorus being available for plankton growth.

The presence of cyanobacteria serves as a reminder of the lake’s/pond’s delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading into the lake/pond by eliminating fertilizer use on lawns, keeping the lake/pond shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

In addition, residents should also observe the lake/pond in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria (blue-green algae) have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to “pile”

cyanobacteria into scums that accumulate in one section of the lake/pond. If a fall bloom occurs, please contact the VLAP Coordinator.

➤ **Table 4: pH**

Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is 6.5, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to page 16 of the "Chemical Monitoring Parameters" section of this report.

The mean pH at the deep spot this season ranged from **5.97** in the hypolimnion to **6.25** in the epilimnion, which means that the water is ***moderately acidic***.

Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake/pond pH.

➤ **Table 5: Acid Neutralizing Capacity**

Table 5 in Appendix B presents the current year and historic epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. For a more detailed explanation, please refer to page 16 of the "Chemical Monitoring Parameters" section of this report.

The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) continues to remain **low** (1.8 mg/L as CaCO<sub>3</sub>) and is ***well below*** the state mean of 6.7 mg/L (Table 5). Specifically, this means that the lake/pond is ***"extremely vulnerable"*** to acidic inputs (such as acid precipitation) and has a ***lower*** ability than many lakes and ponds in the state to buffer against acidic inputs.

➤ **Table 6: Conductivity**

Table 6 in Appendix B presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical

expression of the ability of water to carry an electric current. For a more detailed explanation, please refer to page 16 of the “Chemical Monitoring Parameters” section of this report.

The conductivity has **increased** in the lake/pond and inlets since monitoring began (Table 6). Typically, sources of increased conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake/pond), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity. It is possible that the lower than normal amount rainfall during the latter-half of the summer reduced tributary and lake flushing, which allowed pollutants and ions to build up and resulted in elevated conductivity levels.

We recommend that your monitoring group conduct stream surveys and stormwater sampling along the inlets with elevated conductivity so that we can determine what may be causing the increases. For a detailed explanation on how to conduct a stream survey and stormwater sampling, please refer to this year’s “Special Topic Article” which is included in Appendix D of this report.

➤ **Table 8: Total Phosphorus**

Table 8 in Appendix B presents the current year and historic total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae’s ability to grow and reproduce. Please refer to page 17 of the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

**The inlets were not tested for total phosphorus this season. We recommend sampling the inlets for total phosphorus on each sampling event. This will help us to determine the quality of water that flows into the lake.**

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 in Appendix B shows the dissolved oxygen/temperature profile(s) for the 2002 sampling season. Table 10 shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.



The dissolved oxygen concentration was again **high** at all depths sampled at the deep spot of the lake/pond. As stratified lakes/ponds age, oxygen becomes **depleted** in the hypolimnion (lower layer) by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological oxidation of organic matter (i.e.; biological organisms using oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake/pond where the water meets the sediment. The **high** oxygen level in the hypolimnion is a sign of the lake's/pond's overall good health.

Since 1994, the DES biologist has conducted the temperature and dissolved oxygen profile in **June**. We recommend that the annual biologist visit for the 2003 sampling season be scheduled during **July or August** so that we can determine if oxygen is depleted in the hypolimnion **later** in the sampling season.

➤ **Table 11: Turbidity**

Table 11 in Appendix B lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to page 19 of the "Other Monitoring Parameters" section of this report for a more detailed explanation.

➤ **Table 12: Bacteria (*E.coli*)**

Table 12 lists the current year data for bacteria (*E.coli*) testing. *E. coli* is a normal bacterium found in the large intestines in humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured, and its presence in the water, in defined amounts, indicates that sewage **MAY** be present. If sewage is present in the water, potentially harmful pathogens may also be present. Please consult page 20 of the "Other Monitoring Parameters" section of the report for the current standards for *E. coli* in surface waters. If residents are concerned about sources of *E.coli* such as septic system impacts, animal waste, or waterfowl waste, it is best to conduct *E. coli* testing when the water table is high or after rain events.

The *E.coli* concentration was **low** at each of the sites tested this season. We hope this trend continues!

**OTHER COMMENTS**

- As usual, we had a successful lake ecology day at Lake Monomonac this season! We want to extend a big thanks to all of the volunteers who helped out with the day. We truly enjoyed spending the day with

the Rindge and Winchedon middle school students and were pleased to find out how much many of the students already new about lake ecology. Thank you for supporting the Lake Ecology Program and we look forward to next season's field day. Please give us a call early this spring so that we can mark it on our schedule!

- On the August 27<sup>th</sup> sampling event, the volunteer monitors submitted samples with the station names "1" through "13". This is the first season that numbers have been used to identify the stations. Prior to this season, the tributary stations were labeled with names. Unfortunately, we did not know what station number corresponded to what station name. This made comparing this season's current year data to the historical data impossible. Next season, please label the sample bottles with the station names so that we can compare the current year data with the historical data to determine if any changes in water quality have occurred.
- Since 1995, the annual biologist visit has occurred in conjunction with the ecology field day. With the recent problems with milfoil and the generally large size of the lake it would be beneficial to include second and third sampling events each season. And, as discussed previously, it is important that the biologist visit the lake later in the season to measure the amount of dissolved oxygen in the lake.

#### **USEFUL RESOURCES**

*Changes to the Comprehensive Shoreland Protection Act: 2001 Legislative Session*, NHDES Fact Sheet, (603) 271-3505, or [www.des.state.nh.us/factsheets/sp/sp-8.htm](http://www.des.state.nh.us/factsheets/sp/sp-8.htm)

*Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms*, NHDES Fact Sheet, (603) 271-3505, or [www.des.state.nh.us/factsheets/wmb/wmb-10.htm](http://www.des.state.nh.us/factsheets/wmb/wmb-10.htm)

*The Lake Pocket Book*. Prepared by The Terrene Institute, 2000. (internet: [www.terrene.org](http://www.terrene.org), phone 800-726-4853)

*Managing Lakes and Reservoirs, Third Edition, 2001*. Prepared by the North American Lake Management Society (NALMS) and the Terrene Institute in cooperation with the U.S. Environmental Protection Agency. Copies are available from NALMS (internet: [www.nalms.org](http://www.nalms.org), phone 608-233-2836), and the Terrene Institute (internet: [www.terrene.org](http://www.terrene.org), phone 800-726-4853)

*Organizing Lake Users: A Practical Guide*. Written by Gretchen Flock, Judith Taggart, and Harvey Olem. Copies are available from the Terrene Institute (internet: [www.terrene.org](http://www.terrene.org), phone 800-726-4853)

*Proper Lawn Care in the Protected Shoreland: The Comprehensive Shoreland Protection Act*, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/sp/sp-2.htm](http://www.des.state.nh.us/factsheets/sp/sp-2.htm)

*Sand Dumping - Beach Construction*, WD-BB-15, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/bb/bb-15.htm](http://www.des.state.nh.us/factsheets/bb/bb-15.htm)

*Swimmers Itch*, WD-BB-2, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/bb/bb-2.htm](http://www.des.state.nh.us/factsheets/bb/bb-2.htm)

*Use of Lakes or Streams for Domestic Water Supply*, WD-WSEB-1-11, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/ws/ws-1-11.htm](http://www.des.state.nh.us/factsheets/ws/ws-1-11.htm)

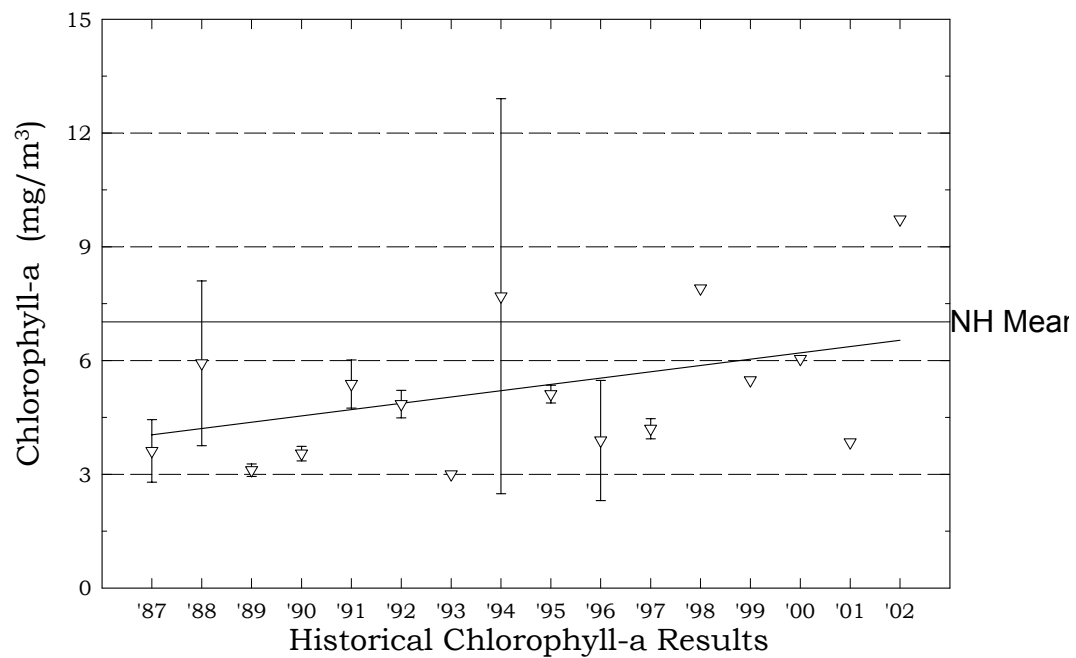
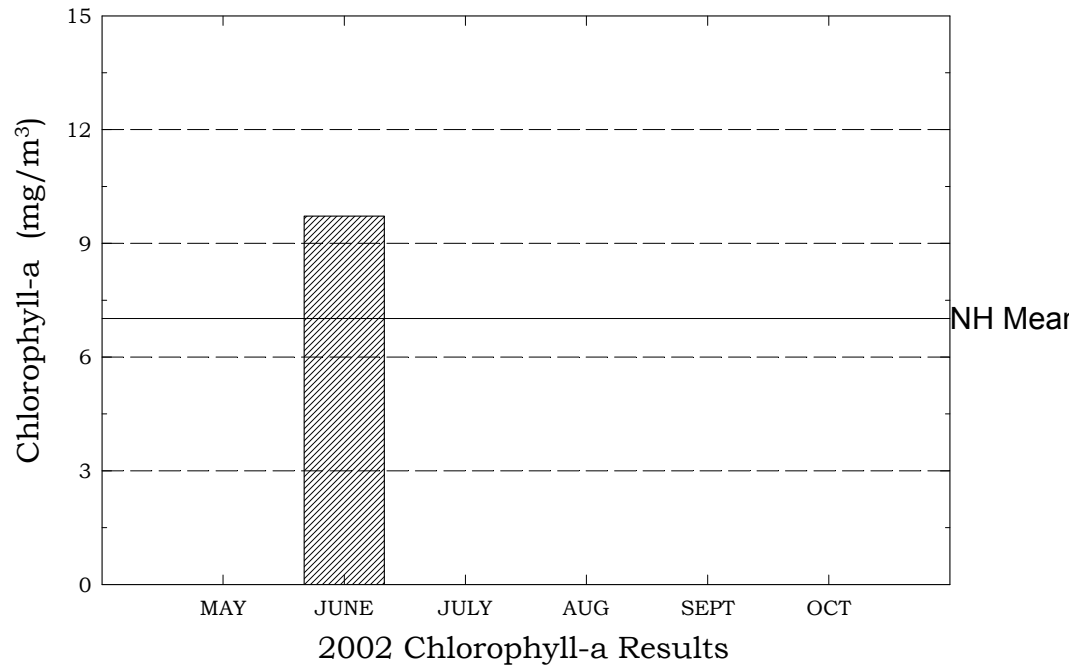
*Water Milfoil*, WD-BB-1, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/bb/bb-1.htm](http://www.des.state.nh.us/factsheets/bb/bb-1.htm)

*Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants*, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or [www.des.state.nh.us/factsheets/bb/bb-4.htm](http://www.des.state.nh.us/factsheets/bb/bb-4.htm)

# Appendix A: Graphs

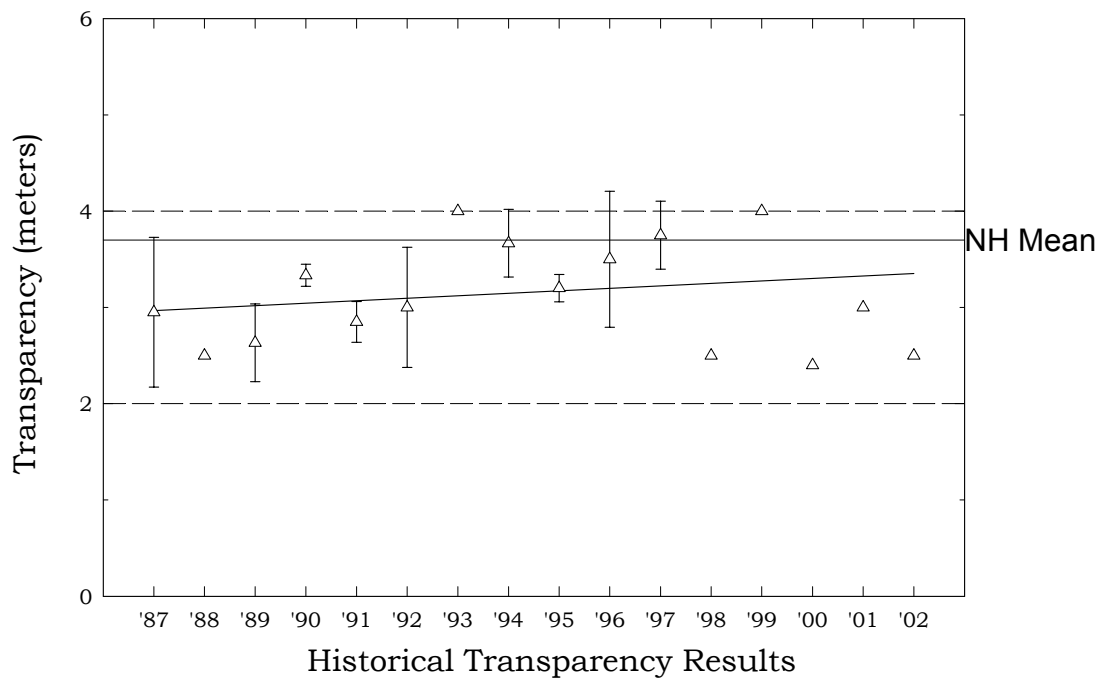
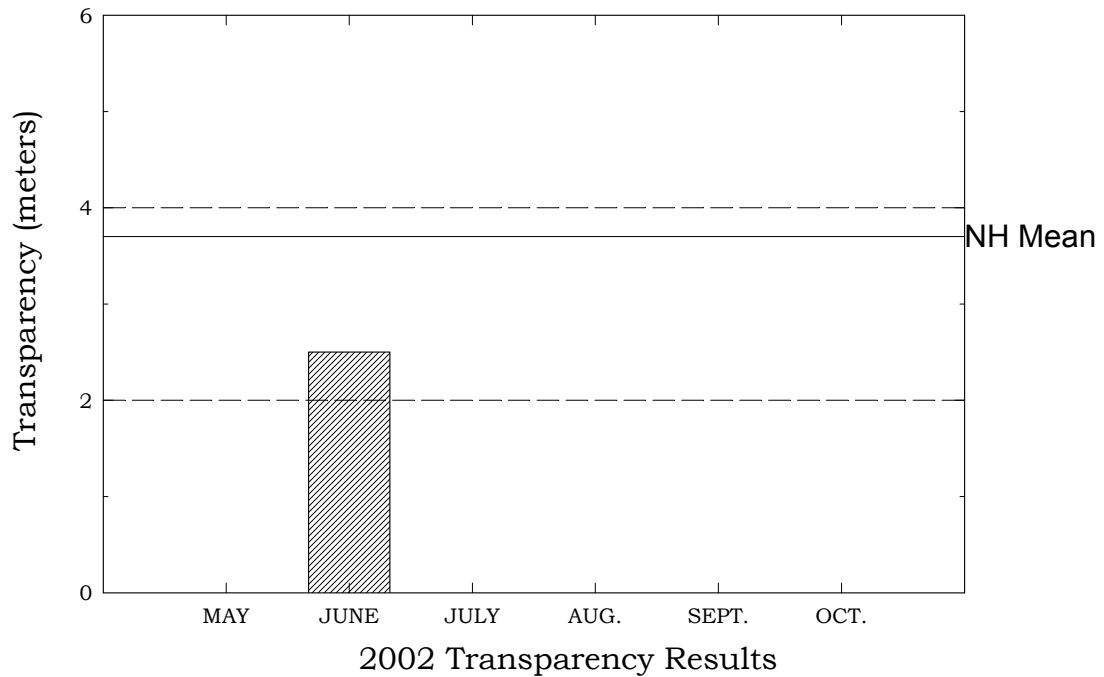
# Lake Monomonac, Rindge

**Figure 1.** Monthly and Historical Chlorophyll-a Results



# Lake Monomonac, Rindge

**Figure 2.** Monthly and Historical Transparency Results



# Lake Monomonic, Rindge

**Figure 3.** Monthly and Historical Total Phosphorus Data.

